an optimum intensity in which they are not directed by the light but move at random. Below this is the sub-optimal and above it the supra-optimal. An animal in either the sub- or supra-optimal intensity is oriented by the rays so that symmetrical points of the body are equally stimulated; this is, of course, accomplished by the placing of the longitudinal axis of the organism in the axis of the ray. And whether an animal orients itself with head toward or away from the source of light (*i.e.*, whether it is positively or negatively phototactic) depends upon the physiological condition of the animal and the intensity of the light. By sub-optimal intensities organisms are supposed to be directed toward the light through the expansion of those motion-producing elements which are on the side most strongly stimulated; hence there results from this kind of orientation a positive reaction. The same organism, if in a supra-optimal intensity, will be oriented with head away from the light, because in this case contraction instead of expansion is caused, and the reaction will be negative. The orientation theory has been very clearly stated by both Loeb and Verworn.

Several different kinds of reactions, representatively selected, are explained by the writers by their theory; among them is the case of a positively phototactic animal moving toward the source of light into a less intensely illuminated region. This reaction has been taken heretofore as evidence of the independent influence of "direction" of ray. It is clearly shown in the present paper, however, that such a contention is probably false, for difference in intensity and the angle at which the organism strikes the side of the vessel are sufficient to explain the observed courses taken under such conditions.

That light acts through intensity alone is a conclusion which this paper makes plausible, but it scarcely justifies the unconditioned statement that it *does not* act by the course which the rays take through the organism. Such a reaction as the reversal of response observed by Towle in Cypridopsis and by Yerkes in Daphnia and Cypris is not easily explained by the hypothesis under consideration. The paper is valuable in that it makes clear the importance of intensity and at the same time indicates the danger of confusion in using direction as a causal term, although intensity does in part depend upon it.

R. M. Y.

Notes. — The chief defects of laboratory guides arise from the difficulty of giving sufficient directions to the student without supplying him with information that he should get from laboratory

study. This is the principal failing in Brown's *Physiology for the Laboratory* (Boston, Ginn & Co., 1900, viii + 167 pp.), which, however, is so well balanced in other respects that it deserves to be in the hands of the teacher if not in those of the pupil.

Kelly (*Jena. Zeitschr.*, Bd. XXXV, p. 429) has pointed out that calcic carbonate occurs in nature in five forms: calcite, aragonite, ktypeite, conchite, and amorphous calcium carbonate. Of these calcite and conchite are the only ones found abundantly in organisms. Conchite is probably slightly more soluble, harder, and has a higher specific weight than calcite. Both forms occur throughout the animal series; thus calcite is the mineral component of the shells of echinoderms, brachiopods, crustacea, bryozoa, of the calcareous spicules of sponges, of the ear stones of fish and amphibia, and of the eggshells of mollusks, most reptiles, and birds; conchite is characteristic of the skeletons of most stone corals, and the shells of many mollusks.

Steinach and later Magnus have shown that the iris of a frog's eye will contract when stimulated by light, even after the eye has been removed from the animal. Steinach believed this to be due to the direct action of light on the sphincter muscle; Magnus attributed it to a short nervous reflex arc within the eye. Guth (*Archiv ges. Physiol.*, Bd. LXXXV, p. 119) finds that frog eyes show this reaction fully two weeks after their removal from the animal,—a period much longer than that during which other organs containing reflex arcs, like the intestine, remain active. Moreover, pieces of the edge of the iris as well as minute isolated groups of muscle fibres from the sphincter pupillæ contract on illumination. As the latter were shown on microscopical examination to contain no ganglion cells, it must be admitted that Steinach's contention that the muscles of the iris are capable of being stimulated directly by light is correct.

BOTANY.

Recent Papers on Algæ. — (Comère, Joseph. *Les Desmidées de France*, Paris, 1901, 222 pp., 16 pls.) In the introduction the author states his double purpose in writing this work; first, to give as full an account as possible of our present knowledge of the desmids; second, a manual for the study and determination of the French